



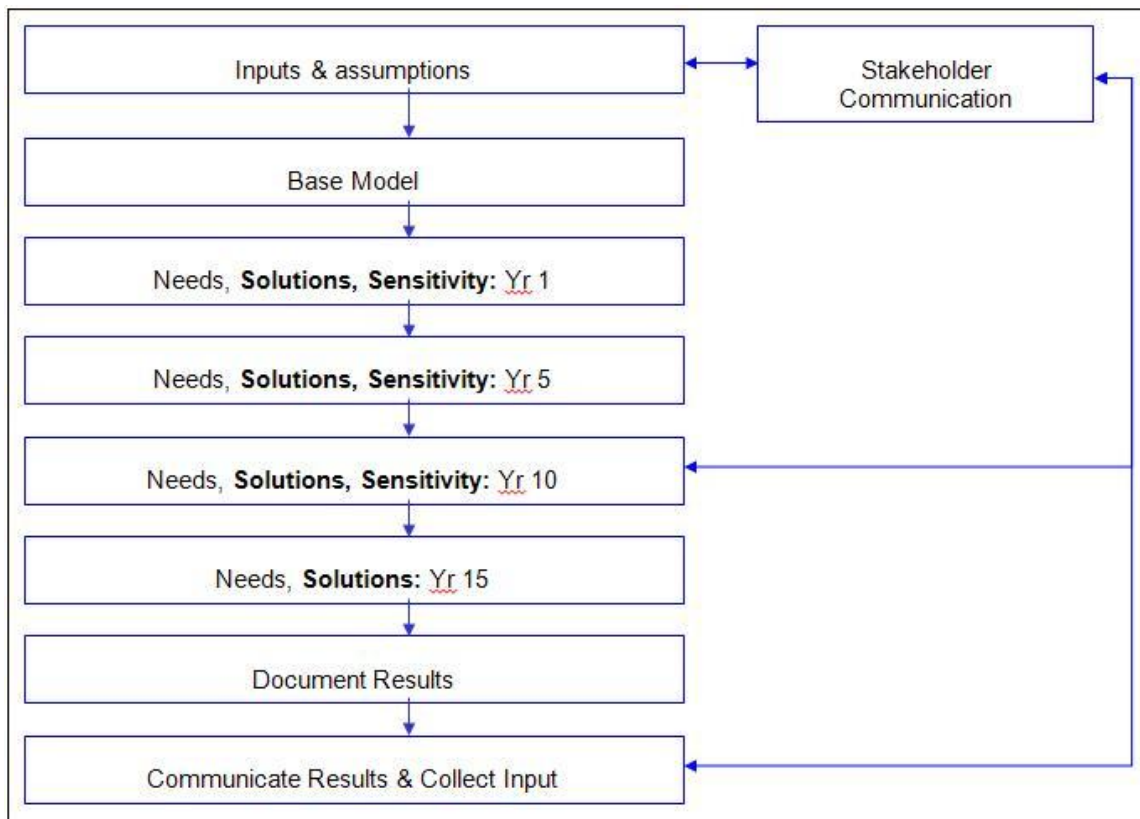
Methodology and Assumptions

1.1 Overview

This section describes the methods and techniques that we use to analyze our network transmission system for this assessment. Economic, regional, environmental and asset management planning processes are covered on other sections of this Web site.

As part of the network assessment, ATC conducted power flow analyses to identify problems or constraints on the transmission system and evaluated the merits of potential reinforcements to address the system limitations that were identified. Once these analyses are complete, ATC meets with our stakeholders to discuss the preliminary results.

ATC's network planning process is summarized in the below figure:



Included in this section is a discussion of which years ATC identified to model to satisfy both the near-term (1 – 5 year horizon) and long-term (5 year and beyond horizon) NERC standards for assessing the transmission system. Also included in this section is discussion on how ATC built each of the models used in this assessment. Discussion items



include topics such as load forecasting, which reinforcements and new generation to include in models, which system load levels, import levels and system bias scenarios to evaluate.

During the network assessment of our transmission system, we performed simulations on a variety of models as discussed below in this section. ATC not only uses these models to identify where constraints or system limitations may exist, but we also use these models in testing the robustness of potential system reinforcements. Per our Planning criteria, constraints or system limitations are identified for NERC Category A type system conditions when bus voltages drop below 95 percent or exceed 105 percent of their nominal voltage or when any system element exceeds its normal rating for the appropriate seasonal model. For NERC Category A or system intact conditions, ATC's Planning criteria also requires for generators to be limited to 90 percent of their maximum reactive power capability within ATC's footprint.

For NERC Category B, C or D contingencies, system limitations or constraints are identified using slightly different criterion. For these types of system contingency conditions, ATC's Planning Criteria identify system limitations when bus voltages drop below 90 percent or exceed 110 percent of their nominal voltage or when any system element exceeds its emergency rating for the appropriate seasonal model. For these three NERC categories, ATC's Planning Criteria requires generators to be limited to 95 percent of their maximum reactive power capability within ATC's footprint. Exceptions to the voltage range criteria apply for certain interconnected entities, and are evaluated in accordance to their signed interconnection agreements. Voltage range exceptions also apply to underground and underwater cables.

The analyses conducted in this transmission system assessment included steady state power flow analyses, stability simulations, multiple outage impacts as well as economic evaluations, generator interconnection impacts, transmission-distribution interconnection impacts and environmental assessment impacts.

1.2 Network Assessment Methodology

American Transmission Co.'s 2011 10-Year Transmission System Assessment provides current results of planning activities and analyses of the company's transmission facilities. These activities and analyses identify needs for network transmission system enhancement and potential projects responsive to those needs.

Since 2001, we have engaged in open and collaborative efforts to share information and solicit input on our plans. We believe that in making our planning efforts transparent and available to the public, the proposals for needed facilities can be more readily understood



and accepted by communities that stand to benefit from them. In recent years the federal government has taken additional steps to ensure that transmission-owning utilities have produced and shared planning information with the public and local stakeholders.

The information in this report provides further foundation for continued public discussions on the transmission planning process, identified transmission needs and limitations, possible resolutions to those needs and coordination with other public infrastructure planning processes.

Computer simulation model years for the 2011 network Assessment analyses were selected in order to meet NERC requirements for a 1-5 year horizon and beyond the 5 year horizon. The years 2012 and 2016 were selected to meet the 1-5 year horizon. The years 2021 and 2026 meet the beyond 5 year horizon. A range of system conditions and study years were developed and analyzed for the 2011 Assessment. Steady state peak load models for all four years were created. In order to determine how close ATC generators were to their maximum reactive power output, two additional models were created for each year. The first model for each year studied reduced ATC generator maximum reactive power by 10 percent. These models were utilized to determine generator reactive power output under intact system conditions (TPL-001-0). A second model for each year was created with net maximum reactive power capability reduced by 5 percent. These models were used for our N-1 (TPL-002-0) analysis.

The needs identified in this Assessment were determined by identifying facilities whose normal or emergency limits are exceeded. The criterion we use to determine what these limits should be is provided in [Planning criteria](#).

This 2011 network Assessment was developed in a chronological fashion. Planned transmission additions expected to be in service by June 2012 were included in the 2012 model, as listed in [Table PF-1](#). Projects for which we have completed our analysis and are either under construction, have filed an application to construct, or are in the process of preparing an application were included in the 2016, 2021 and 2026 models as appropriate based on projected in service dates (See [Tables PF-2, PF-3 and PF-4](#)).

1.2.1 Load forecast

Steady state summer peak models are built using our customers' load forecasts (50/50 projections) as a starting point, meaning that there is a 50 percent chance that the load level will either fall below or exceed the customer projection. Customer load forecasts were gathered for all ATC customers through the year 2020 (and in some cases 2021/2026). The forecasts were compared to previous historical and forecasted data to ensure validity and consistency. As a final step, the finalized forecast information was



forwarded back to our individual customers to ensure their concurrence. Once consensus was achieved, the data was incorporated into our models.

Certain ATC customers did not provide an 11th-year load forecast for the year 2021. To obtain a forecast for 2021, certain customer-provided forecasts were extended by growing their load by using a 3-year linear growth rate calculated over the last three years of the forecasts provided by the customer. Load power factors were held at their 2020 levels. Non-scalable loads were also held at their 2020 levels using this methodology.

The 2026 summer peak load model was developed utilizing similar methodology. To obtain a projection for 2026, customer-provided forecasts were extended by growing their load by using a 3-year linear growth rate calculated over the last three years of the forecasts provided by the customer. Load power factors were held at their 2020 (or 2021) levels. Non-scalable loads were once again held at their 2020 (or 2021) load levels. It should be noted that the loads utilized in the 2026 summer peak model do not reflect an actual load forecast, but merely a projection (or “load model”) based upon the best available information. The purpose for the 2026 projection is not to develop projects to address all issues, but to develop a sense for the need(s) for long lead-time projects.

ATC Peak Load Projections (MW) including line losses

Year	MW load	Compounded growth rate
2011	13,111	N/A
2012	13,258	N/A
2016	13,805	1.02% (2012-2016)
2021	14,531	1.03% (2016-2021)
2026	15,292*	1.03% (2021-2026)
Overall		1.03% (2011-2026)

**load model, not a load forecast*

It should be noted that we worked with the distribution companies as much as possible to confirm forecast variations from past trends. In a few cases we revised power factors to reasonable levels to prevent creating expensive transmission projects for voltage support. In most cases these issues would ultimately be solved through distribution system power factor correction. ATC will be in ongoing discussions with our customers to determine the best plan for these situations.



1.2.2 Model building

1.2.2.a Assumptions common to all models

The following assumptions are common to all models studied in the 10-Year Assessment. Any exceptions are listed within the respective assumption section:

- New Generation
- Generation Retirements
- Cutoff dates
- Generation Project Schedule
- Generation outside of the System
- Generation Dispatch
- Line and Equipment ratings
- Project Criteria

1.2.2.a.1 New generation

There have been numerous generation projects proposed within ATC's service territory. Many of these proposed projects have interconnection studies completed and a few have had transmission service facility studies completed. Several have proceeded to or through the licensing phase and several more are under construction. However, there are numerous proposed generation projects that have dropped out of the generation queue (refer to Generation interconnections), adding considerable uncertainty to the transmission planning process. To address this planning uncertainty, we have adopted a criterion for purposes of this and prior Assessments, to establish which proposed generation projects would be included in the 2011 Assessment models.

Previously (before the advent of the MISO Day 2 market) the criterion was that those generation projects for which, at the time the models were developed,

1. ATC had completed a generation interconnection impact study, a generation interconnection facility study, a transmission service impact study and a transmission service facility study, and
2. The generation developer or a customer of the developer had accepted the transmission service approved by ATC.

In the 2011 10-Year Assessment, the criterion was broken into two time frames, years 1 through 5 and 6+ years.

1. For years 1 through 5, only those generators with FERC approved interconnection agreements will be included in the planning models.
2. Beginning with year 6 and continuing into the future, generators are only required to have a Facility Study completed in order to be included in the 10-Year Assessment models.



A number of wind generators in the ATC footprint have suspended FERC approved interconnection agreements. For the first three years following their requested in-service dates, ATC criterion calls for modeling these facilities but dispatching them at the bottom of the dispatch order. After the three years, the generators will be dispatched in their normal dispatch order. The wind generators with suspended agreements were included in the models built for the 10-Year Assessment analysis. The 2011 and 2012 models showed these generators as out of service. The 2016 and 2021 models should have had these generators in-service and dispatched.

1.2.2.a.2 Generation retirements

On occasion, generators connected to the ATC transmission system are retired or mothballed. As a result, we developed criteria to determine when generators should no longer be included in our 10-Year Assessment models. If the generator has a completed MISO Attachment Y study, the generator will be disconnected in the appropriate load flow study models. In addition, ATC sent an annual letter to each generation owner. Generating companies were asked to identify generator retirements or mothballing that should be included in ATC’s planning horizon. Generators identified as such by the customer will be modeled off line in the relevant models.

There are generators that have been publicly announced as likely candidates for retirement. However, using the disconnection criteria above, in the 2011 10-Year Assessment models we assumed the following generators were to be out of service:

Plant Name	Zone	Installed capacity	Assumed out of service
Rock River 1	3	71 MW	Jan 2011
Rock River 2	3	75 MW	Jan 2011
Blackhawk 3	3	24 MW	Jan 2011
Blackhawk 4	3	25 MW	Jan 2011
Blount 3	3	39 MW	Jan 2013
Blount 4	3	22 MW	Jan 2013
Blount 5	3	28 MW	Jan 2013
Net decrease in 2011		195 MW	
Net decrease after 2011		284 MW	

Please note that recently some of our customer generators reduced their maximum MW outputs, but those reductions occurred after the cutoff points defined below.

1.2.2.a.3 Cutoff dates



For model building purposes, we assumed cutoff dates for generation changes to be included in models. In order to include the latest data in the models, cutoff dates correspond to the dates the models were built as follows:

- 2012 models - October 25, 2010
- 2016 models - October 25, 2010
- 2021 models - October 25, 2010
- 2026 models - October 25, 2010

It was assumed that if the generator was available as of the cutoff date, it was available for dispatch in that grouping of models.

1.2.2.a.4 Generation projects schedule

To maintain the schedule needed to complete this Assessment, the models were developed during late 2010 and early 2011. Only those generation projects that qualified to be included in our planning models as of the various cutoff dates, were included in the Assessment models. For generation projects not in service by June 2011, the criterion above resulted in the following proposed generation projects being included in the applicable power flow models:

Plant Name	Zone	Installed capacity increase	Dispatched increase	Assumed in-service
Point Beach #1	4	103 MW	103 MW	Dec 2011
Point Beach #2	4	105 MW	105 MW	Jul 2011
Quilt Block wind farm	3	19.6 MW	19.6 MW	Dec 2012
Glacier Hills wind farm	3	49.8 MW	49.8 MW	Dec 2011
Stoney Brook wind farm	4	19.7 MW	19.7 MW	Mar 2012
EcoMet wind farm	4	20.1 MW	20.1 MW	Dec 2012
Ledge wind farm	4	30.0 MW	30.0 MW	Dec 2012
Lake Breeze wind farm	4	19.6 MW	19.6 MW	Oct 2013
Net increase by Dec 2011		802.4 MW		
Net increase 2011-2020		49.6 MW		

**wind farm Installed capacity lists is 20% of total installed capacity*

A more comprehensive discussion of proposed generation is provided in Generation Interconnections, including a map showing all of the currently active generation interconnection requests that ATC has received (See Figure PR-9.)

1.2.2.a.5 Generation outside system



The model for the system external to ATC was taken from the most appropriate model included in the MMWG 2010 Series models. The external system interchange was adjusted from the 2010 MMWG Series models to match the latest ATC members' firm interchange with the exception of the Shoulder 70%, East to West Bias and the West to East Bias models which were built to represent a 3000, 1700 and 700 MW imports into ATC respectively.

1.2.2.a.6 Generation dispatch

Balancing Authority (Control) area generation was dispatched based on economic dispatch for that Balancing Authority with the exception of the Shoulder 70%, West to East Bias and Light Load models.

1.2.2.a.7 Line and equipment ratings

We revised line and equipment ratings based on updates to our Substation Equipment and Line Database (SELD). As of April 2011, nearly 76 percent of all ATC lines and 91 percent of ATC transformers have SELD ratings that have been validated. Additionally, nearly 97 percent of ATC lines 100 kV or higher have ratings in SELD that have been validated. Ratings not yet validated in SELD generally are based on the ratings received from the utilities that contributed the facilities to ATC.

1.2.2.a.8 Project criteria

All of the models built for the Assessment include revised system topology based on projects that were placed in service in the model year, or were anticipated to be placed in service by June 15 of that year. Refer to Tables PF-1 through PF-4 for projects that were included in the analyses. Please also refer to the Project deficient seasonal models for more discussion about how projects are chosen for inclusion our models.

1.2.2.b Steady state power flow models

1.2.2.b.1 Normal (Category A) Conditions

The load flow models for the 10-Year Assessment are built to include established (pre-contingency) operating procedures to assess system performance under the normal (Category A) conditions as required in the TPL-001-0 Reliability Standard. The relevant operating procedures are generally standing operating procedures that apply for the planning horizon. These procedures include, but are not limited to, normal open points and switched capacitor banks. Normal Open points are assumed to remain normally open in the base cases. Changes in the status of Normally Open points are provided by the system planners that participate in the decision to change the status of a Normally Open point. Switched non-mobile capacitor banks are assumed to be available for use by the system operators, except in the case of planned outages. This availability is represented by modeling these capacitor banks in the discrete adjustment voltage regulating mode. Mobile capacitor banks are modeled in the base case when there is a known date



and location in the planning horizon during which the mobile capacitor bank is planned to be in service.

1.2.2.b.2 Planned Maintenance and Construction Outages

The load flow models for the 10-Year Assessment are built to include maintenance and construction outages that are planned to occur in planning horizon. These outages are typically conditions that are expected to last for a period of six months or more. The modeled outages are provided by the system planners that participate in the decision to schedule the maintenance or construction outage.

1.2.2.b.3 Protection Systems

All existing and planned protection systems, including any backup or redundant systems that would be applicable to a given contingency were simulated in the studies and analyses.

1.2.2.b.4 Control Devices

All existing and planned control devices that would be applicable to a given contingency were simulated in the studies and analyses. These control devices include transformer automatic tap changers, capacitor bank automatic controls, and Distribution Superconducting Magnetic Energy Storage (DSMES) units

1.2.2.b.5 Project deficient seasonal models

The load flow models built for the 10-Year Assessment are special models built exclusively for system analyses in the Assessment. Some projects were purposely left out of these models in order to verify system problems and determine which problems worsen over time. We have taken the approach of evaluating subsequent summer peak seasons in each of our annual Assessments to determine the immediacy of needs identified, hence providing a means of prioritization.

The 2012, 2016, 2021 and 2026 steady state project deficient summer peak models were developed to evaluate needs, verify findings of the previous year's Assessment, and confirm that previously identified needs will increase over time. The 2021 and 2026 project deficient models reflect years sufficiently forward in time to determine the need for and assess the performance of larger-scale projects (345-kV lines, for example) that could be expected to be in service in that timeframe.

1.2.2.b.6 All project seasonal models

After the initial analyses portion of the 10-Year Assessment was completed, "All Project" models were built. The "All Project" models were built with all planned and proposed projects included as well as the majority of the provisional projects. These models are more indicative of the expected system configurations for the three study years. The "All Project" models are more appropriate for internal studies performed by ATC planners throughout



the year and for regional models. As part of the 10-Year Assessment, the zone planners perform contingency analyses on each of the “All Project” models. These analyses will verify whether all of the planned, proposed, and provisional projects will resolve issues revealed in the 10-Year Assessment process and will not introduce any new limitations.

1.2.2.b.7 Load, dispatch and interchange profiles

1.2.2.b.7.a Load Sensitivities (2016)

ATC planning explored two sensitivity analyses in our 2011 10-Year Assessment analyses, the minimum (light load) scenario and the west to east bias scenario. The modeling details of these sensitivities are outlined below.

1.2.2.b.7.a.1 Minimum load scenario (2012)

- ATC Load: 6,035 MW
 - 2010 forecast collection, scalable loads reduced to 40% of peak + non-scalable loads = 46% of Peak load
- Total ATC Generation: 5,856 MW
- Includes all planned and proposed projects to be in-service by 6/15/2012
- *Interchange*: Firm interchange only as of 10/25/2010
- *Dispatch*: ATC-wide Merit order as of 10/25/2010

1.2.2.b.7.a.2 West to East Bias scenario (2016, 2021)

- ATC Peak Load: 9,496 MW
 - 2010 forecast collection, scalable loads reduced to 65% + non-scalable loads = 69% of Peak load as drawn from Operations historical data
- Total ATC Generation: 9,160 MW
- Includes all planned and proposed projects to be in-service by 6/15/2016
- *Interchange*: ATC net as provided in Operations data -700 MW
- *Dispatch*: ATC-wide Merit order as of 10/25/2010
- *Special additions*:
 - Wind generation in the ATC footprint dispatched to 45% of P_{max} as drawn from Operations historical data,
 - Wind generation west of ATC dispatched to 50% as drawn from Operations historical data,
 - Wind Generation south of ATC dispatched to 55% as drawn from Operations historical data,
 - Minnesota-Wisconsin Export interface (MWEX) loaded to 1400 MW
 - Manitoba Hydro Exports set to 1,350 MW
 - All generation increases were modeled to generation reductions south and east of ATC



1.2.2.b.7.b Summer peak (2012, 2016, 2021, 2026)

- We utilized interconnection point load forecasts provided by various distribution companies in 2010 for both real and reactive power components of load. Please refer to the Load Forecast section for further details.
- Only firm interchange was included in our analyses.
- Special additions: none

1.2.2.b.7.b.1 Summer peak 95% Q_{Max} (2012, 2016, 2021, 2026)

- We utilized interconnection point load forecasts provided by various distribution companies in 2010 for both real and reactive power components of load. Please refer to the Load Forecast section for further details.
- Only firm interchange was included in our analyses.
- Special additions: Generator Q_{Max} reduced to 95%.

1.2.2.b.7.b.2 Summer peak 90% Q_{Max} (2012, 2016, 2021, 2026)

- We utilized interconnection point load forecasts provided by various distribution companies in 2010 for both real and reactive power components of load. Please refer to the Load Forecast section for further details.
- Only firm interchange was included in our analyses.
- Special additions: Generator Q_{Max} reduced to 90%.

1.2.2.b.7.c High load model (2016)

- We utilized interconnection point load forecasts provided by various distribution companies in 2010. The 2016 high load (or “hot summer”) model was created by increasing load 5 percent above expected summer peak conditions as a proxy for a 90/10 model in order to determine in-service date sensitivity to load growth that is higher or weather that is warmer than forecasted. Please refer to the Load Forecast section for further details.
- The system external to ATC was taken from the MMWG 2010 Series, 2016 summer model.
- The external system interchange was adjusted from the 2010 MMWG Series 2016 summer interchange to match latest ATC members’ firm interchange.
- ATC load forecast increased by 5% above the summer peak load forecast using a constant power factor.

1.2.2.b.7.d Shoulder 70% models (2016, 2021)

- We utilized interconnection point load forecasts provided by various distribution companies in 2010.
- The 2016 and 2021 shoulder models were created by selectively scaling down loads that generally vary by time-of-day to approximately 70 percent of the summer peak condition. A 70 percent load level was chosen to represent the shoulder model



because under this scenario, flows are changing as a result of the Ludington pumping cycle. However, we recognize that loads at individual points will vary under real-time shoulder conditions.

- The shoulder 70% model included a 3000 MW import into ATC. Firm interchange plus economic transactions up to a 3000 MW import were included.

1.2.2.b.7.e Shoulder 90% models (2016, 2021)

- We utilized interconnection point load forecasts provided by various distribution companies in 2010. The 2016 shoulder 90% model was created by decreasing load 10 percent below expected summer peak conditions. Please refer to the Load Forecast section for further details.
- To simulate a steady state reverse east-west bias power flow, models were developed with 90% load levels, 1700 MW import into ATC, and a 2000 MW transaction from east to west.
- ATC system biased in an East to West direction.

1.2.2.b.7.f Model years

We started model development for this Assessment by building a system model that represented 2011 summer peak conditions. This 2011 model is referred to as an “as-planned” model because essentially everything in the model is certain to be in service by 2011 summer. This model then was modified to create each of the subsequent Assessment study models including the changes previously described for each model.

Computer simulation model years for the 2011 network Assessment analyses were selected in order to meet NERC requirements for a 1-5 year horizon and beyond the 5 year horizon. The years 2012 and 2016 were selected to meet the 1-5 year horizon. The years 2021 and 2026 meet the beyond 5 year horizon. The years 2012, 2016 and 2021 were chosen to coordinate with the most recently released MMWG models that were available.

The 2012, 2016, 2021 and 2026 models were developed to evaluate needs, verify findings of the 2010 Assessment, and confirm that previously identified needs will increase over time. The 2021 and 2026 models reflect years sufficiently forward in time to determine the need for and assess the performance of larger-scale projects (345-kV lines, for example) that could be expected to be in service in that timeframe.

1.2.2.c Dynamic stability/short-circuit assessment models

ATC conducts transient analyses to evaluate dynamic stability of generators as part of our study of new generation interconnections and voltage stability analysis on portions of the system where severe low voltages are identified. In instances where our stability criteria were not met, remedial projects were devised and included in this Assessment (see System stability).



ATC also conducts a short circuit analysis of the entire system on an annual basis or as part of our study of new generation interconnections to evaluate the adequacy of circuit breakers on the transmission system. In instances where short-circuit duties exceeded existing circuit breaker ratings, plans for circuit breaker replacements have been included in this Assessment.

1.2.3 Preliminary needs and solution development

1.2.3.a Steady state project-deficient needs assessment

1.2.3.a.1 System intact and single contingency simulations

ATC performed system intact and single contingency simulations on the 2012, 2016, 2021 and 2026 models. Single contingency simulations include the following: single element (line, transformer, generator, bus and switched shunt) and event-based breaker-to-breaker outages. We run these simulations for summer peak and under the sensitivity situations described above.

1.2.3.a.2 Comparison of results vs. Planning Criteria

The models described above are analyzed and compared to our Planning Criteria. Limits that approach or exceed our criteria are then listed in Tables ZS-1 through ZS-4.

1.2.3.a.3 Reconciliation of significant changes to power flow results

To reconcile changes in power flow results between Assessments, zone planners run data comparisons to determine if limitations identified in prior Assessments have become more severe, less severe, or have been mitigated. Steps are taken to verify topology and other model changes to ensure that the results are consistent with all of the available information.

1.2.3.a.4 Future considerations

In future Assessments, we plan to communicate needs and solicit solution development options to our stakeholders earlier in the process.

1.2.3.b Preliminary Solution Development

1.2.3.b.1 New Limitation

If a new limitation is found in the initial screening, the zone planner will take steps to ensure that the limitation is valid, including verification of the power flow model. If the new limitation



is within the current five-year timeframe, the zone planner will then check for potential delayability, including investigation of operating guides or other mitigation measures.

After all potential mitigation measures for a given limitation or need have been evaluated, system solution options are developed. Potential projects that may resolve identified needs are vetted internally and with our external customers. Each solution option is subject to sufficient evaluation to determine its effect upon the identified limitation. After all discussion and collaboration has concluded, the results for all the solution options evaluation are recorded in a project development document.

Cost estimates are developed for solution options that effectively address the identified limitation. After cost information has been obtained, the zone planner selects the most efficient solution option from a cost-benefit standpoint and initiates the project development process by completing the project request form to create a provisional project. Finally, the project request is processed through ATC's Project Approval Process.

1.2.3.b.2 Repeat Limitation

If a previously identified limitation is found in our initial screening, the zone planner will re-verify that existing solution options address that limitation. If an in-service date or scope change is warranted, updated cost estimates are developed. The project request form is then updated with the revised in-service date, cost, scope, and/or justification. The updated project request form is then resubmitted through ATC's Project Approval Process.

1.2.3.b.3 Unspecified Network Project (Placeholder) Process

Unspecified Network Projects are defined as those projects which may shift into the 10-year timeframe as a result of:

- Changing load forecast,
- Changes in generation and distribution interconnection projects,
- Changes in mandatory reliability or renewable portfolio standards, and/or
- Additional projects that are driven by economic benefits or multiple outage impacts.

Several million dollars were set aside in ATC's budget in order to address Unspecified Network Projects. ATC's placeholder process begins with internal discussions to determine how to best serve our customers' local and regional needs. In these discussions, we collaboratively determine which potential projects may be built or incur costs within the 10-year Assessment period. Projects with a 50 percent probability of occurrence or greater are estimated. The cost/benefit results are discussed, vetted and approved by our AIM



Executive committee. After consensus is reached, our capital forecast is updated to include these placeholder dollars.

1.2.3.c All Projects Assessment

After the 10-Year Assessment analysis is completed, models are built that include all planned, proposed, and some provisional projects. These models are called “All Projects” models and are more indicative of the expected system configurations for 2012, 2016, 2021 and 2026 study years. These models are more appropriate for internal planning studies performed throughout the year.

As part of the 10-Year Assessment, zone planners perform a contingency analysis on each of the “All Projects” models. The contingency analysis includes systematically removing each line, generator, transformer, switched shunt and modeled bus ties individually to determine the effect on the transmission system. The analysis will verify whether all of the planned, proposed, and provisional projects will resolve issues revealed in the Assessment process.

The zone analysis discussions presented in this Assessment provides a list of reinforcements that are beginning to optimize our reinforcement plans, at least at the one- or maybe two-zone level. Three important questions regarding this plan include the following:

- How do the reinforcements for all the zones perform together?
- Does applying a solution in one zone create a problem that was not seen before in another zone?
- Are some zone solutions redundant when all the solutions are applied to the system?

As we did in the 2010 Assessment, this year we attempted to address the first two questions. We built year 2012, 2016, 2021 and year 2026 models that included reinforcements reflecting our best thoughts on all of the most likely planned, proposed, and provisional projects to address the identified issues. These projects are those identified in the project tables for this Assessment with specific in-service dates. First contingency analysis was performed on these new models, including selected outages on neighboring systems. This analysis showed that the reinforcements in total did indeed deal with the issues identified and did not create any new issues to be resolved. Please refer to the All Projects section for details of our analyses.

1.2.3.d Stability review & analysis



For system stability analyses methodology and results see the Generator Stability, Voltage Stability and Small Signal Stability sections of the System Stability section.

1.2.3.e Multiple Outage Review and Analysis

We conduct a variety of multiple outage analyses. For steady state analyses methodology and results see the Multiple Outage Analysis section.

1.2.4 Documentation

1.2.4.a Writing/approval processes

The 10-Year Assessment is written and developed by several contributors. The following steps are performed in order to ensure cohesive, consistent information:

- Requests are made for the latest financial, environmental, demographics, asset renewal and economics information from other ATC departments.
- Drafts of each section's text, figures and tables are compiled for peer review.
- A comprehensive meeting is held with all Planning and Asset Renewal managers and team leaders in order to review and approve the information.
- A summary presentation of all Assessment information is reviewed and approved by ATC management.

Once the information has been approved by all parties, the hard copy Summary Report and Zone Summaries are printed and distributed, and the Full Report text is posted at www.atc10yearplan.com.

*Table PF-1
Projects included in the 2012 10-Year Assessment Model*

System additions	Planning zone
Council Creek transformer #1 replacement	1
G588 MEWD current transformer	1
Badger West T-D interconnection	1
Whitcomb-Wittenberg 69-kV rebuild	1
Y-95 asset management uprate	1
McKenna and Chaffee Creek capacitor banks	1
Monroe County second 161/69-kV transformer	1
Woodmin T-D interconnection	1
Straits-McGulpin 138-kV line uprate	2
Indian Lake 69-kV capacitor banks	2
Presque Isle updates	2
Nordic-Perch Lake 69-kV asset management uprate	2
Autrain line uprate	2
Forsyth-Munising 138-kV line uprate	2
Nine Mile-Roberts asset management uprate	2
Chandler second 138/69-kV transformer	2
Indian Lake-Hiawatha 138/69 LTC	2
Stoughton North T-D interconnection	3
Nine Springs-Pflaum asset management uprate	3
Y61 69-kV line uprate	3
Blue River-Muscoda asset management rerate	3
Hillman Substation upgrade	3
REC Milton T-D interconnection	3
Gran Grae-Boscobel asset management project	3
Blount-Ruskin underground project	3
Y62 maintenance rebuild	3
Bass Creek 138/69-kV transformer and X12 uprate	3
Stage Coach-Timberlane 69-kV asset management rerate	3
Oregon-Stoughton uprate	3
Dane County corrective plan (Kegonsa and Femrite capacitor banks)	3
Spring Green 69-kV capacitor banks	3
Femrite #4 T-D interconnection	3
Y128 asset management uprate	3
Walnut T-D interconnection	3
Brodhead-South Monroe 69-kV line rebuild	3
McCue-Milton Lawns 69-kV line uprate	3
Glacier Hills G706/H012 G-T interconnection and associated uprates	3
Dam Heights T-D interconnection	3
Richmond T-D interconnection	3
Fountain Prairie T-D interconnection	3
Beloit Gateway T-D interconnection	3
Ellinwood transformer #2 replacement	4

Table PF-1 (continued)
Projects included in the 2012 10-Year Assessment Model

System additions	Planning zone
North Fond du Lac transformer #31/32 replacements	4
Kewaunee-East Krok asset management uprate	4
Kewaunee second transformer	4
Sunset Point-Pearl 69-kV line rebuild	4
G833-J022-J023 G-T interconnections	4
Point Beach GSU	4
G590 G-T interconnection	4
Canal-Dunn Road 138-kV line project	4
Bain-Kenosha 138-kV line uprate	5
Shorewood-Humboldt second underground cable	5
Harbor transformer replacement T-D interconnection	5
Barland T-D interconnection	5
Pleasant Prairie-Zion 345-kV line uprate	5
Bluemound #1 and #3 transformer replacements	5

*Table PF-2
Projects included in the 2016 10-Year Assessment Model**

System additions	Planning zone
Council Creek-Petenwell line uprate	1
Construct Monroe County-Council Creek 161-kV line and Timberwolf 69-kV switching station	1
G749 G-T interconnection	3
G282 G-T interconnection	3
Uprate Fitchburg-Nine Springs 69-kV and Royster-Pflaum 69-kV lines and move AGA load to the Royster-Femrite 69-kV line	3
Rockdale-Cardinal 345-kV line	3
Blount distribution capacitor bank retirement	3
Hawk T-D interconnection	3
West Middleton T7 T-D interconnection	3
Y-8 asset management rebuild	3
Little Suamico T-D interconnection	4
G611/G927 G-T interconnection	4
G773 G-T interconnection	4
Forest Avenue T-D interconnection	4
G427 G-T interconnection	4
Milwaukee County T-D interconnection	5

**Projects included in addition to those listed in Table PF-1*

*Table PF-3
Projects included in the 2021 10-Year Assessment Model**

System additions	Planning zone
Close Seney-Blaney/Uprate 69-kV Inland line	2
G8334-J0223 G-T interconnection/Barnhart-Branch River project	4
Center third transformer T-D interconnection	5

**Projects included in addition to those listed in Tables PF-1 and PF-2*

*Table PF-4
Projects included in the 2026 10-Year Assessment Model**

System additions	Planning zone
None	

**Projects included in addition to those listed in Tables PF-1, PF-2 and PF-3*

Table ZS-1
2012 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2012 Summer Peak Case		2012 Minimum Load Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
1	Base case loading criteria exceeded	FALSE	--	FALSE	--	System Intact
1	Base case voltage criteria exceeded	--	FALSE	--	FALSE	System Intact
1	Council Creek 138-kV bus	--	89.1% - 89.2%	--	--	Council Creek - Petenwell 138-kV line ACEC Badger West - Saratoga 138 KV line ACEC Badger West - Petenwell 138 KV line Saratoga - Petenwell 138-KV line
1	Badger West 138-kV bus	--	89.3%	--	--	ACEC Badger West - Saratoga 138 KV line
1	Petenwell 138-kV bus	--	89.3%	--	--	ACEC Badger West - Saratoga 138 KV line ACEC Badger West - Petenwell 138 KV line Saratoga - Petenwell 138-KV line
2	Base case loading criteria exceeded	FALSE	--	FALSE	--	System Intact
2	Base case voltage criteria exceeded	--	FALSE	--	TRUE	System Intact
2	M38 – Atlantic 69-kV line	94.6%	--	--	--	M38 – Atlantic 138-kV line M38 – Atlantic 138-kV line ⁵
2	Chandler – Lakehead Tap 69-kV line Masonville – Lakehead Tap 69-kV line Gladstone – North Bluff 69-kV line Madonville – Gladstone 69-kV line	108.5% 104.3% 97.3% 97.2%	--	--	--	Delta – Mead 69-kV line
2	Delta – Mead 69-kV line	97.3%	--	--	--	Chandler – Lakehead 69-kV line
2	Engadine, Newberry, LouPac, Newberry Hospital, Newberry Village, Roberts 69-kV buses	--	90.9 - 91.3%	--	--	Hiawatha – Engadine 69-kV line
2	North Bluff, Bay View, Mead, Gladstone, Masonville and Lakehead 69-kV buses	--	84.2 - 89.1%	--	--	Delta – Mead 69-kV line
2	Mead and Bay View 69-kV buses	--	--	--	90.4-91.0%	Delta – Mead 69-kV line
2	Alger Delta, Munising, Alger 69-kV buses	--	--	--	105.4-105.5%	System Intact
2	Atlantic 138-kV bus	--	--	--	113.7%	Atlantic – M38 138-kV line
3	Base Case Loading Criteria Exceeded	FALSE	--	FALSE	--	System Intact
3	Base Case Voltage Criteria Exceeded	--	FALSE	--	TRUE	System Intact
3	Royster – AGA Gas Tap 69-kV line	109.0%	--	--	--	Fitchburg – Syene 69-kV line
3	Royster – Sycamore 69-kV line	95.5%	--	--	--	Femrite 138/69-kV transformer
3	Darlington 138-kV bus	--	--	--	105.2%	System Intact
3	Huiskamp 138-kV bus	--	90.5%	--	114.8%	Huiskamp – North Madison 138-kV line
3	Verona 138-kV bus	--	90.9%	--	114.6%	Verona – Oak Ridge 138-kV line

Table ZS-1
2012 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2012 Summer Peak Case		2012 Minimum Load Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
3	Hubbard and Hustisford 138-kV buses	--	87.5% 88.1% 88.1%	--	90.1% 90.2% 90.2%	Rubicon – Hustisford 138-kV line Hustisford – Hubbard 138-kV line Rubicon – Hustisford – Hubbard 138-kV line
4	Base case loading criteria exceeded	FALSE	--	FALSE	--	System Intact
4	Base case voltage criteria exceeded	--	FALSE	--	FALSE	System Intact
4	Sunset Point – Pearl Avenue 69-kV line	106.7% 106.4%	--	--	--	Ellinwood – 12th Avenue 69-kV line Ellinwood 138/69-kV transformer ³
5	Base Case Loading Criteria Exceeded	FALSE	--	FALSE	--	System Intact
5	Base Case Voltage Criteria Exceeded	--	FALSE	--	TRUE	System Intact
5	Albers, Allerton, Hayes, Kenosha, Nicholson, Oak Creek, Pennsylvania, Racine, Ramsey, St. Rita, and Somers 138-kV buses	--	--	--	105-106.1%	System Intact
5	Maple and Germantown 138-kV buses	--	91.7% 91.2%	--	--	Maple – Saukville 138-kV line
5	Bain 345/138-kV transformer #5	108.3% 158.2%	--	--	--	Split Pleasant Prairie 345-kV bus 34 Split Pleasant Prairie 345-kV bus 23
5	Oak Creek 345/230-kV transformer T895	104% 100.1%	--	--	--	Split Oak Creek 230-kV bus 78 Split Oak Creek 230-kV bus 67
5	Arcadian4 – Waukesha1 138-kV line	98.8%	--	--	--	Arcadian6 – Waukesha3 138-kV line
5	Arcadian6 – Waukesha3 138-kV line	95.7%	--	--	--	Arcadian4 – Waukesha1 138-kV line Split Waukesha 138-kV bus 12
5	Harbor – Kansas 138-kV line	94.8%	--	--	--	Kansas – Norwich 138-kV line

Table ZS-2
2016 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2016 Summer Peak Case		2016 70% Load Case		2016 90% Load Case		2016 105% Load Case		2016 65% High W-E Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
1	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
1	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	TRUE	--	FALSE	--	TRUE	System Intact
1	Council Creek 138-kV bus	--	104.9%	--	--	--	105.3%	--	--	--	105.4%	System Intact
1	Dartford 69-kV bus	--	91.2 - 91.4%	--	--	--	--	--	--	--	--	Ripon - Northwest Ripon Tap 69-KV line Metomen - Ripon 69-KV line
1	Petenwell 138/69 KV transformer	98.0 - 95.2%	--	--	--	--	--	98.1%	--	115.5%	--	Castle Rock - Quincy ACEC 69-KV line Hilltop - Buckhorn Tap 69-KV line Castle Rock - McKenna 69-kV line ¹ McKenna - Quincy ACEC 69-KV line
1	ACEC Badger West - Saratoga 138-kV line	--	--	95.2 - 96.8%	--	--	--	--	--	95.8 - 100.9%	--	Arpin - Eau Claire 345-kV line King - Eau Claire - Arpin 345-kV line ⁵
1	ACEC Badger West - Petenwell 138-kV line	--	--	98.2 - 99.8%	--	--	--	--	--	95.8 - 103.9%	--	Arpin - Eau Claire 345-kV line King - Eau Claire - Arpin 345-kV line ⁵
2	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
2	Base case voltage criteria exceeded	--	FALSE	--	TRUE	--	FALSE	--	FALSE	--	FALSE	System Intact
2	Mead and Chandler 69-kV buses	--	--	--	--	--	--	--	--	--	95.1 - 95.9%	System Intact
2	Munising, Alger, Alger-Delta 69-kV buses	--	--	--	105-105.5%	--	--	--	--	--	--	System Intact
2	Lakota Road 115-kV bus	--	--	--	105.30%	--	--	--	--	--	--	System Intact
2	Indian Lake 69-kV bus	--	--	--	--	--	--	--	--	--	92.0% 91.1% 91.6% 91.7%	Pleasant Prairie – Zion 345-kV line Pleasant Prairie – Zion 345-kV line ²⁷ Indian Lake 69-kV capacitor bank Perkins 138-kV capacitor bank
2	Indian Lake 138/69-kV transformer #1 Indian Lake 138/69-kV transformer #2	--	--	--	--	--	--	--	--	97.2-98.2%	--	Indian Lake 138/69-kV transformer #2 Indian Lake 138/69-kV transformer #1
2	Delta – Mead 69-kV line	102.3% 97.4% 97.1%	--	--	--	--	--	101.7% 96.8% 96.7%	--	--	--	Chandler – Lakehead Tap 69-kV line Masonville – Lakehead Tap 69-kV line Chandler - Lakehead - Masonville 69-kV line ²⁶
2	Chandler – Lakehead Tap 69-kV line Masonville – Gladstone 69-kV line Masonville – Lakehead Tap 69-kV line	112.8% 96.9% 108.5%	--	101.8% 90.7% 98.8%	--	108.6% 94.3% 104.7%	--	114.8% 97.9% 110.2%	--	103.9% 93.4% 101.1%	--	Delta – Mead 69-kV line
2	M38 – Atlantic 69-kV line	--	--	--	--	--	--	96.3% 96.5% 100%	--	--	--	M38 – Atlantic 138-kV line Atlantic 138/69-kV transformer M38 – Atlantic 69-kV line ²³
2	Engadine, Newberry, Newberry Hospital, Roberts, LouPac, Newberry Village, Hulbert and Eckerman 69-kV buses	--	90.3-90.7%	--	--	--	91.5-91.9%	--	91.3-91.7%	--	--	Hiawatha – Engadine 69-kV line
2	North Bluff, Bay View, Mead, Gladstone, Lakehead, Masonville 69-kV buses	--	84.7-91.8%	--	85.5-90.1%	--	84.9-89.6%	--	83.7-91.6%	--	82.3-90.5%	Delta – Mead 69-kV line
2	Empire - Presque Isle 138-kV line	--	--	--	--	--	--	--	--	100.6%	--	Split Empire 138-kV bus #23
2	Escanaba and West 69-kV buses	--	91.4-91.9%	--	--	--	--	--	--	--	--	Delta - West Tap 69-kV line
2	Nordic – Mountain 69-kV line	--	--	--	--	--	--	--	--	102.0% 110.5%	--	Empire – Forsyth 138-kV line Plains – Arnold 138-kV line

Table ZS-2
2016 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2016 Summer Peak Case		2016 70% Load Case		2016 90% Load Case		2016 105% Load Case		2016 65% High W-E Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
3	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
3	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact
	Royster – Sycamore 69-kV line	98.2%	--	--	--	--	--	--	104.5%	--	--	Femrite 138/69-kV transformer
3	Verona 138-kV bus	--	89.4%	--	--	--	89.9%	--	88.8%	--	--	Verona – Oak Ridge 138-kV line
3	Huiskamp 138-kV bus	--	89.9%	--	91.7%	--	90.4%	--	89.9%	--	91.7%	Huiskamp – North Madison 138-kV line
3	Darlington – North Monroe 138-kV line	--	--	--	--	--	--	--	--	102.0 – 95%	--	Paddock 345/138-kV transformer Darlington 138/69-kV transformer Darlington – DPC Gratiot 69-kV line
3	Eden – Mineral Point 69-kV line	--	--	--	--	--	--	--	--	95.3%	--	Darlington – Lafayette Wind 138-kV line
3	South Monroe – Browntown 69-kV line	--	--	--	--	--	--	--	--	97.0%	--	Darlington – North Monroe 138-kV line
3	Concord 138-kV bus	--	--	--	--	--	--	--	96.0%	--	--	System Intact
3	Hubbard and Hustisford 138-kV buses	--	87.5% 88.2% 88.2%	--	87.1% 87.4% 87.4%	--	87.2% 86.5% 86.5%	--	--	--	87.2% 87.9% 87.9%	Rubicon – Hustisford 138-kV line Hustisford - Hubbard 138kV line Rubicon - Hustisford - Hubbard 138kV line
4	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
4	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact
4	Manrap – Custer 69-kV line	--	--	--	--	--	--	95.4%	--	--	--	Dewey – Lakefront 69-kV line
4	Lau Road – Elkhart Lake 138-kV line	--	--	--	--	--	--	--	--	95.6% 95.6% 95.6%	--	Sheboygan Energy Center – Grandville 345-kV line Point Beach – Sheboygan Energy Center 345-kV line Point Beach 345-kV bus tie 1 - 2
4	Elkhart Lake – Saukville 138-kV line	--	--	--	--	--	--	--	--	106.7% 106.7% 106.6% 103.4% 102.9% 101.9 – 95.0%	--	Point Beach 345-kV bus tie 1 - 2 Point Beach – Sheboygan Energy Center 345-kV line Sheboygan Energy Center – Granville 345-kV line Cypress – Arcadian 345-kV line Edgewater – Cedarsauk 345-kV line Plus other less severe contingencies
4	Gravesville - Glenview 138-kV line	96.7% 96.7% 96.6% -- --	--	--	--	--	--	--	102.9% 102.9% 102.9% 96.0% 96.0%	--	--	Tecumseh Road 138/69 kV Transformer* Tecumseh Road 138/69 kV Transformer Tecumseh Road - Ford Drive tap 69-kV line Ford Drive tap - New Holstein 69-kV line Tecumseh Road - New Holstein 69-kV line*
4	Sunset Point – Pearl Avenue 69-kV line	107.9% 107.9%	--	--	--	97.0% 96.9%	--	113.6% 113.4%	--	--	--	Ellinwood – 12th Avenue 69-kV line Ellinwood 138/69-kV transformer*
5	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
5	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact
5	Bain 345/138-kV transformer #5	158.6% 111.4%	--	142.5% --	--	158.8% --	--	158.3% 106.4%	--	142.6% 127.1%	--	Split Pleasant Prairie 345-kV bus 34 Split Pleasant Prairie 345-kV bus 23
5	Oak Creek 345/230-kV transformer T895	104.2% 101.5%	--	--	--	104.4% --	--	104.3% 101.9%	--	--	--	Split Oak Creek 230-kV bus 78 Split Oak Creek 230-kV bus 67
5	Arcadian4 – Waukesha1 138-kV line	97.9%	--	114.1%	--	130.4%	--	98.5%	--	--	--	Arcadian6 – Waukesha3 138-kV line
5	Arcadian6 – Waukesha3 138-kV line	94.7% --	--	110.5% 100.4%	--	126.3% 112.7%	--	95.4% --	--	--	--	Arcadian4 – Waukesha1 138-kV line Split Waukesha 138-kV bus 12

Table ZS-2
2016 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2016 Summer Peak Case		2016 70% Load Case		2016 90% Load Case		2016 105% Load Case		2016 65% High W-E Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
5	Arcadian 345/138-kV transformer #3	--	--	--	--	96.2% 99.6% 94.9%	--	--	--	--	--	Split Arcadian 345-kV bus 12 Arcadian 345-kV bus outage Arcadian 345/138-kV transformer #1
5	Bain – Kenosha 138-kV line	--	--	--	--	--	--	--	--	100.3%	--	Pleasant Prairie – Zion 345-kV line
5	Pleasant Prairie – Zion 345-kV line	--	--	--	--	--	--	--	--	96.8%	--	Zion – Arcadian 345-kV line ²⁷
5	Granville 345/138-kV transformer #1	--	--	--	--	108.2%	--	--	--	--	--	Split Granville 345-kV bus 23
5	Harbor – Kansas 138-kV line	--	--	110.4% 105.3% 102.5% 101.7%	--	100.0% -- -- --	--	--	--	--	--	Kansas – Norwich 138-kV line Dewey – Norwich 138-kV line Split Dewey 138-kV bus Dewey – Montana 138-kV line Plus Other Less Severe Outages
5	Albers – Kenosha 138-kV line	--	--	107.2%	--	105.6%	--	--	--	--	--	Albers – Bain 138-kV line
5	Edgewood – St. Martins 138-kV line	--	--	98.1%	--	--	--	--	--	--	--	Merrill Hills – Waukesha 138-kV line
5	Oak Creek – Ramsey 138-kV line Kansas – Ramsey 138-kV line Nicholson – Ramsey 138-kV line	--	--	--	--	101.0% 96.1% 95.1%	--	--	--	--	--	Oak Creek – Pennsylvania 138-kV line
5	Waukesha 138-kV bus 12	--	--	--	--	99.7%	--	--	--	--	--	Arcadian6 – Waukesha3 138-kV line
5	Kenosha – Lakeview 138-kV line	--	--	--	--	--	--	96.2%	--	126.9%	--	Pleasant Prairie – Zion 345-kV line
5	Lakeview – Zion 138-kV line	--	--	--	--	--	--	--	--	129.9%	--	Pleasant Prairie – Zion 345-kV line

Table ZS-3
2021 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2021 Summer Peak Case		2021 Minimum Load Case		2021 70% Shoulder Case		2021 90% E-W Bias Case		2021 65% High W-E Bias Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
1	Base case loading criteria exceeded	TRUE	--	FALSE	--	FALSE	--	FALSE	--	TRUE	--	System Intact
1	Base case voltage criteria exceeded	--	FALSE	--	TRUE	--	FALSE	--	FALSE	--	FALSE	System Intact
1	Dartford, Ripon Industrial Park, Northwest Ripon and Ripon 69-kV buses	--	90.5 - 91.9% 90.6 - 91.9% 91.6%	--	--	--	--	--	--	--	--	Ripon - NW Ripon Tap 69-KV line Metomen - Ripon 69-KV line NW Ripon Tap - Dartford Tap 69-KV line
1	Winneconne, Omro and Omro Industrial Park 69-kV buses	--	90.8 - 91.4%	--	--	--	--	--	--	--	--	Winneconne - Sunset Point 69-kV line
1	Council Creek 161-kV bus	--	91.2%	--	--	--	--	--	--	--	--	Monroe County - La Crosse 161-kV line
1	Council Creek 138-kV bus	--	--	--	105.5%	--	--	--	--	--	--	System Intact
1	Metomen 138/69 KV transformer	95.6%	--	--	--	--	--	--	--	--	--	System Intact
1	Petenwell 138/69 KV transformer	101.7% 106.2% 104.1% 103.5% 101.4 - 103.3%	--	--	--	95.6 - 104.2%	--	--	--	119.2%	--	System Intact Castle Rock - Quincy ACEC 69-KV line Hilltop - Buckhorn Tap 69-KV line Castle Rock - McKenna 69-kV line ¹⁴ Plus other less severe contingencies
1	Castle Rock - ACEC Quincy 69-KV line	98.8% 98.8% 98.7%	--	--	--	--	--	--	--	--	--	Petenwell - Big Pond 69-KV line Petenwell 138/69-kV Transformer Necedah Tap - Big Pond 69-KV line
1	ACEC Badger West - Petenwell 138-kV line	--	--	--	--	96.9 - 135.9%	--	--	--	96.1 - 103.8%	--	Arpin - Eau Claire 345-kV line King - Eau Claire 345-kV line Arpin 345/138-kV transformer Arrowhead - Stone Lake 345-kV line Plus other less severe contingencies
1	ACEC Badger West - Saratoga 138-kV line	--	--	--	--	97.1 - 132.7%	--	--	--	100.5%	--	Arpin - Eau Claire 345-kV line King - Eau Claire 345-kV line Arpin 345/138-kV transformer Arrowhead - Stone Lake 345-kV line Plus other less severe contingencies
2	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
2	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact
2	Engadine, Newberry, Newberry Hospital, Roberts, LouPac, Newberry Village, Hulbert, Eckerman 69-kV buses	--	84.4-90.4% --	--	--	--	--	--	88.5-89.0% 89.5-89.8%	--	--	Hiawatha-Engadine 69-kV line Engadine-Newberry 69-kV line
3	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
3	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact
3	Darlington - North Monroe 138-kV line	--	--	--	--	--	--	--	--	118.8 - 98.8%	--	Paddock 345/138-kV transformer Darlington 138/69-kV transformer Darlington - DPC Gratiot 69-kV line Eden - Wyoming Valley 138-kV line Eden - Wyoming Valley - Spring Green 138-kV line plus other less severe contingencies
3	Eden - Mineral Point 69-kV line	--	--	--	--	--	--	--	--	111.3 - 98.5%	--	Darlington - Lafayette Wind 138-kV line
3	South Monroe - Browntown - Jennings Road - Wiote 69-kV line	--	--	--	--	--	--	--	--	110.8 - 101.2%	--	Darlington - North Monroe 138-kV line
3	Nelson Dewey 161/138-kV transformer	--	--	--	--	96.0%	--	--	--	--	--	System Intact
3	Nelson Dewey 161/138-kV transformer	--	--	--	--	103.1 - 99.4%	--	--	--	--	--	Nelson Dewey Unit 2 Pleasant Praire Unit 1 Pleasant Praire Unit 2 Edgewater Unit 5 plus other less severe contingencies
3	Royster - Sycamore 69-kV line	106.3%	--	--	--	--	--	96.3%	--	--	--	Femrite 138/69-kV transformer

Table ZS-3
2021 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2021 Summer Peak Case		2021 Minimum Load Case		2021 70% Shoulder Case		2021 90% E-W Bias Case		2021 65% High W-E Bias Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
3	Westport – Wanakee Muni#2 69-kV line	98.1%	--	--	--	--	--	--	--	--	--	West Middleton – Pheasant Branch 69-kV line
3	Verona 138-kV bus	--	87.9%	--	--	--	90.8%	--	88.8%	--	91.4%	Verona – Oak Ridge 138-kV line Verona 138/69-kV transformer
3	Huiskamp 138-kV bus	--	89.4%	--	114.8%	--	90.1%	--	90.4%	--	91.4%	Huiskamp – North Madison 138-kV line
3	Hubbard and Hustisford 138-kV bus	--	87.5% 88.1% 88.1%	--	87.5% 87.6% 87.6%	--	86.9% 87.3% 87.3%	--	88.1% 88.1% 88.1%	--	87.2% 87.2% 87.1%	Rubicon – Hustisford 138-kV line Hustisford – Hubbard 138-kV line Rubicon – Hustisford – Hubbard 138-kV line
3	Paddock – Townline 138kV line	--	--	--	--	102.8% 101.8% 101.1%	--	--	--	--	--	NW Neloit – Paddock 138-kV line Paddock – NW Beloit – Blackhawk 138-kV line NW Beloit – Blackhawk 138-kV line
3	NW Beloit – Paddock 138kV line	--	--	--	--	96.9%	--	--	--	--	--	Paddock – Townline 138-kV line
4	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
4	Base case voltage criteria exceeded	--	FALSE	--	TRUE	--	FALSE	--	FALSE	--	FALSE	System Intact
4	Manrap – Custer 69-kV line	99.3%	--	--	--	--	--	--	--	--	--	Dewey – Lakefront 69-kV line
4	Glenview – Gravesville 69-kV line	103.7% 103.7% 103.7% 97.0% 97.0%	--	--	--	--	--	--	--	--	--	Tecumseh Road 138/69 kV Transformer* Tecumseh Road 138/69 kV Transformer Tecumseh Road - Ford Drive tap 69-kV line Ford Drive tap - New Holstein 69-kV line Tecumseh Road - New Holstein 69-kV line*
4	Sunset Point – Pearl Avenue 69-kV line	110.5% 110.4%	--	--	--	--	--	98.9% 98.9%	--	--	--	Ellinwood 138/69-kV transformer* Ellinwood – 12th Avenue 69-kV line
4	Morgan – Falls 138-kV line	--	--	--	--	101.8%	--	--	--	--	--	Morgan – Plains 345-kV line
4	Elkhart Lake – Saukville 138-kV line	--	--	--	--	--	--	--	--	97.9%	--	Barnhart – Cedarsauk 345-kV line
4	Kewaunee 138-kV bus	--	--	--	103.6%	--	--	--	--	--	--	System Intact
5	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
5	Base case voltage criteria exceeded	--	FALSE	--	TRUE	--	FALSE	--	FALSE	--	FALSE	System Intact
5	Oak Creek 345/230-kV transformer T895	104.3% 102.5%	--	--	--	--	--	104.4% 102.5%	--	102.7% 99.8%	--	Split Oak Creek 230-kV bus 78 Split Oak Creek 230-kV bus 67
5	Bain 345/138-kV transformer #5	158.4% 104.6%	--	--	--	--	--	--	--	--	--	Split Pleasant Prairie 345-kV bus 34 Split Pleasant Prairie 345-kV bus 23
5	Arcadian4 – Waukesha1 138-kV line	98.4%	--	--	--	110.2%	--	120.4%	--	--	--	Arcadian6 – Waukesha3 138-kV line
5	Arcadian6 – Waukesha3 138-kV line	95.3%	--	--	--	106.8% 95.8%	--	116.6% 102.0%	--	--	--	Arcadian4 – Waukesha1 138-kV line Split Waukesha 1-2 bus
5	Arcadian 345/138-kV transformer #3	--	--	--	--	--	--	95.9%	--	--	--	Arcadian 345/138-kV transformer #1
5	Pleasant Prairie – Zion 345-kV line	--	--	--	--	--	--	--	--	108.2% 101.1% 98.8%	--	Zion – Arcadian 345-kV line Zion - Arcadian 345-kV line ¹⁴ System Intact
5	Lakeview – Zion 138-kV line Arcadian – Zion 345-kV line Kenosha - Lakeview 138-kV line	96.8% -- 99.6%	--	--	--	--	--	--	--	144% 108.1% 141.9%	--	Pleasant Prairie – Zion 345-kV line
5	Bain – Kenosha 138-kV line	--	--	--	--	--	--	--	--	107.8%	--	Pleasant Prairie – Zion 345-kV line
5	Albers – Kenosha 138-kV line	--	--	--	--	100.4%	--	--	--	--	--	Albers – Bain 138-kV line
5	Maple and Germantown 138-kV buses	--	--	--	--	--	--	--	89.7-90.3%	--	--	Saukville – Maple 138-kV line

Table ZS-4
2026 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2026 Summer Peak Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	
1	Base case loading criteria exceeded	TRUE	--	System Intact
1	Base case voltage criteria exceeded	--	TRUE	System Intact
1	Silver Lake, ACEC Spring Lake, Redgranite, Fountain Valley, River Run, Berlin and Fox River 69-kV buses	--	90.0 - 91.7% 91.0 - 91.2% 91.2 - 91.4% 91.8 - 91.9%	Wautoma – Silver Lake Tap 69-kV line Ripon - Northwest Ripon Tap 69-kV line Metomen – Ripon 69-kV line Silver Lake – ACEC Spring Lake 69-kV line
1	Dartford, Ripon Industrial Park, Northwest Ripon and Ripon 69-kV buses	--	96.4% 88.3 - 89.8% 88.5 - 89.9% 90.4 - 91.8%	System Intact Ripon - Northwest Ripon Tap 69-KV line Metomen – Ripon 69-kV line Northwest Ripon Tap - Dartford Tap 69-KV line
1	Winneconne, Omro and Omro Industrial Park 69-kV buses	--	89.4 - 90.0%	Winneconne – Sunset Point 69-kV line
1	Castle Rock – ACEC Quincy 69-kV line	101.1%	--	Necedah Tap – Big Pond 69-kV line Pettenwell – Big Pond 69-kV line Pettenwell 138/69-kV transformer
1	Metomen 138/69 KV transformer	100.5% 101.4% 100.0%	--	System Intact North Fond du Lac 138/69-kV transformer North Fond du Lac – Rosendale Tap 69-kV line
1	Pettenwell 138/69-kV transformer	106.2% 110.2% 107.9% 107.5% 107.3% 98.6 - 106.2%	--	System Intact Castle Rock – Quincy ACEC 69-kV line McKenna – Quincy ACEC 69-kV line Hilltop – Buckhorn Tap 69-kV line Castle Rock - McKenna 69-kV line ²⁵ Plus other less severe contingencies
1	Wautoma - ACEC Wautoma Tap 69-kV line	96.9%	--	Harrison North - Harrison 69-kV line
2	Base case loading criteria exceeded	FALSE	--	System Intact
2	Base case voltage criteria exceeded	--	FALSE	System Intact
2	Hulbert, Eckermann, Lou-Pac, Newberry Village, Roberts, Talantino 69-kV buses	--	83.5 - 89.4% 88.1 - 91.5% 86.4 - 90.8% 86.7 - 91.2%	Engadine – Newberry 69-kV line Newberry – Newberry Hospital 69-kV line Newberry Hospital – Roberts 69-kV line Hiawatha – Roberts 69-kV line 6911 ²⁴
3	Base case loading criteria exceeded	FALSE	--	System Intact
3	Base case voltage criteria exceeded	--	FALSE	System Intact
3	Timberlane Tap – West Middleton 69-kV line	95.6%	--	Spring Green 138/69-kV transformer
3	West Middleton – Pheasant Branch 69-kV line	107.8 – 96.5%	--	Waunakee Switching – Waunakee Municipal 2 69-kV line Westport – Waunakee Municipal 2 69-kV line West Middleton 138/69-kV transformer
3	West Middleton 138/69-kV transformer	--	--	West Middleton 138/69-kV transformer
3	Westport – Waunakee Muni2 69-kV line	114.7%	--	West Middleton – Pheasant Branch 69-kV line
3	Waunakee Industrial Park – Huiskamp 69-kV line	95.7%	--	West Middleton – Pheasant Branch 69-kV line
3	Royster – Sycamore 69-kV line	115.0%	--	Femrite 138/69-kV transformer
3	Huiskamp 138-kV bus	--	88.7%	Huiskamp – North Madison 138-kV line
3	Verona 138-kV bus	--	86.0%	Verona – Oak Ridge 138-kV line
3	Hubbard and Hustisford 138-kV bus	--	87.0% 87.7% 87.7%	Rubicon – Hustisford 138-kV line Hustisford – Hubbard 138-kV line Rubicon – Hustisford – Hubbard 138-kV line
3	Alto 69-kV bus	--	96.8%	System Intact
4	Base case loading criteria exceeded	FALSE	--	System Intact
4	Base case voltage criteria exceeded	--	FALSE	System Intact
4	Manrap – Custer 69-kV line	106.2%	--	Dewey – Lakefront 69-kV line

Table ZS-4
2026 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2026 Summer Peak Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	
4	Glenview – Gravesville 69-kV line	101.5% 101.5% 101.5%	--	Tecumseh Road 138/69-kV transformer ²⁴ Tecumseh Road 138/69-kV transformer Tecumseh Road – Ford Drive 69-kV
4	Sunset Point – Pearl Avenue 69-kV line	113.2% 112.9%	--	Ellinwood – 12th Avenue 69-kV line Ellinwood 138/69-kV transformer ²⁰
5	Base Case Loading Criteria Exceeded	FALSE	--	System Intact
5	Base Case Voltage Criteria Exceeded	--	FALSE	System Intact
5	Bluemound 230-kV buses #1, #2 and #3	--	95.8%	System Intact
5	Brookdale East, Allerton 138-kV buses	--	95.5 - 95.9%	System Intact
5	Bain 345/138-kV transformer #5	158.9% 99.5%	--	Split Pleasant Prairie 345-kV bus 34 Split Pleasant Prairie 345-kV bus 23
5	Oak Creek 345/230-kV transformer T895	102.4% 104.7%	--	Split Oak Creek 230-kV bus 67 Split Oak Creek 230-kV bus 78
5	Kenosha – Lakeview 138-kV line	103.0%	--	Pleasant Prairie – Zion 345-kV line
5	Lakeview – Zion 138-kV line	99.3%	--	Pleasant Prairie – Zion 345-kV line
5	Pennsylvania 138-kV bus	--	91.6%	Oak Creek – Pennsylvania 138-kV line
5	Arcadian – Waukesha 138-kV line	--	96.8%	Arcadian – Waukesha 138-kV line

Table ZS-7: ATC System Angular Stability Assessment for 2011 10-Year Assessment (as of July 1, 2011)

	Facility Studied	# Units	Total Capacity (MW)	Last Year Of Detail Study	Response to Selected NERC Category B, C and D Contingencies (NERC Reliability Criteria)				SPS	Note
					2011	2012-2015	2016	Appropriate for 2017-2021		
Existing Units										
1	Pleasant Prairie	2	1208.0	2007	Acceptable (1,2,3)	Acceptable (1,2,3)	Acceptable (1,2,3)	Yes	No	See notes (4,5)
2	Paris	4	400.0	2008	Acceptable (1,2,3)	Acceptable (1,2,3)	Acceptable (1,2,3)	Yes	No	2008 TYA
3	Oak Creek	7	1138.0	2007	Acceptable (1,2,3)	Acceptable (1,2,3)	Acceptable (1,2,3)	Yes	No	See note (5)
4	Valley	2	280.0	2009	Acceptable (2,3)	Acceptable (2,3)	Acceptable (2,3)	Yes	No	2009 TYA, See note (6)
5	Germantown	5	345.0	2010	Acceptable (3)	Acceptable (3)	Acceptable (3)	Yes	No	2010 TYA, See note (7)
6	Port Washington	6	1080.0	2009	Acceptable (2,3)	Acceptable (2,3)	Acceptable (2,3)	Yes	No	2009 TYA, See note (8)
7	Point Beach	2	512; 514	2009	Acceptable (2,3)	Acceptable (2,3)	Acceptable (2,3)	Yes	Yes	See note (9)
8	Kewaunee	1	579.0	2009	Acceptable (2,3)	Acceptable (2,3)	Acceptable (2,3)	Yes	No	2009 TYA
9	Edgewater	3	773.0	2010	Acceptable (3)	Acceptable (3)	Acceptable (3)	Yes	Yes	2010 TYA, See note (10)
10	S. Fond du Lac	4	352.0	2010	Acceptable (3)	Acceptable (3)	Acceptable (3)	Yes	No	2010 TYA
11	Neevin	2	300.0	2005	Acceptable (20)	Acceptable (20)	Acceptable (20)	Yes	No	2011 TYA
12	De Pere	1	185.0	2010	Acceptable (3)	Acceptable (3)	Acceptable (3)	Yes	No	2010 TYA, See note (11)
13	Pulliam	6	459.0	2005	Acceptable (20)	Acceptable (20)	Acceptable (20)	Yes	No	2011 TYA
14	West Marinette	4	240.0	2009	Acceptable (2,3)	Acceptable (2,3)	Acceptable (2,3)	Yes	No	2009 TYA
15	Fox Energy	3	672.3	2008	Acceptable (1,2,3)	Acceptable (1,2,3)	Acceptable (1,2,3)	Yes	No	2008 TYA, See note (9)
16	Sheboygan Energy	2	343.0	2005	Acceptable (20)	Acceptable (20)	Acceptable (20)	Yes	No	2011 TYA, See note (9)
17	Cypress	88	145.2	2009	Acceptable (2,3)	Acceptable (2,3)	Acceptable (2,3)	Yes	No	2009 TYA
18	Forward Energy Center	86	129.0	2008	Acceptable (1,2,3)	Acceptable (1,2,3)	Acceptable (1,2,3)	Yes	No	2008 TYA
19	Columbia	2	1050.0	2005	Acceptable (18)	Acceptable (18)	Acceptable (18)	Yes	No	2011 TYA
20	Christiana	3	544.5	2005	Acceptable (19)	Acceptable (19)	Acceptable (19)	Yes	No	2011 TYA
21	Riverside	3	659.1	2010	Acceptable (3)	Acceptable (3)	Acceptable (3)	Yes	No	2010 TYA
22	Rock River	5	132.0	2010	Acceptable (3)	Acceptable (3)	Acceptable (3)	Yes	No	2010 TYA
23	Nelson Dewey	2	226.0	2010	Acceptable (1,2,3)	Acceptable (1,2,3)	Acceptable (1,2,3)	Yes	No	See note (12)
24	University	2	236.0	2008	Acceptable (1,2,3)	Acceptable (1,2,3)	Acceptable (1,2,3)	Yes	No	2008 TYA
25	Concord	4	400.0	2008	Acceptable (1,2,3)	Acceptable (1,2,3)	Acceptable (1,2,3)	Yes	No	2008 TYA
26	West Campus	3	147.2	2009	Acceptable (2,3)	Acceptable (2,3)	Acceptable (2,3)	Yes	No	2009 TYA
27	Presque Isle	5	431.0	2007	Acceptable (2,3)	Acceptable (2,3)	Acceptable (2,3)	Yes	Yes	See note (13)
28	Weston	5	552.6	2005	Acceptable (20)	Acceptable (20)	Acceptable (20)	Yes	No	2011 TYA
26	Elm Road	1	1230.0	2007	Acceptable (1,2,3)	Acceptable (1,2,3)	Acceptable (1,2,3)	Yes	No	See note (5)
New / Future Units with Signed Interconnection Agreement										
27	EcoMet (wind)	67	100.5	2008	See note (17)	See note (17)	See note (17)	See note (17)	No	See note (14)
22	Glacier Hills (wind)	138	249.0	2009	See note (15)	See note (15)	See note (15)	See note (15)	No	See note (15)
23	Lake Breeze	49	98.0	2004	See note (17)	See note (17)	See note (17)	See note (17)	No	See note (16)

These shaded rows represent units at plants in which there have been a significant system topological change near the plant or significant parameter changes or updates to the dynamic models used in stability studies and are to be studied in the 2011 TYA as part the system angular stability analysis

Notes:

- Comparing 2009 TYA models with 2008 TYA models, no significant change has occurred near the generation station, other than the local load growth. Therefore, the stability results from the 2008 TYA are still applicable and are acceptable in the following years.
- Comparing 2010 TYA models with 2009 TYA models, no significant change has occurred near the generation station, other than the local load growth. Therefore, the stability results from the 2009 TYA are still applicable and are acceptable in the following years.
- Comparing 2011 TYA models with 2010 TYA models, no significant change has occurred near the generation station, other than the local load growth. Therefore, the stability results from the 2010 TYA are still applicable and are acceptable in the following years.
- Since 2009 TYA Pleasant Prairie Special Protection System (SPS) study was completed on May 27, 2009 and concluded the SPS was no longer required and could be retired.
- "Final Facility Study Update – Revision 2 Phase I, II & III Milwaukee County, Wisconsin MISO #G051 (#36760-01)" dated January 15, 2007.
- Replacement of breaker failure relays and breakers required per 2009 TYA.
- Addition of redundant bus differential relays and reduction of delayed clearing times required per 2010 TYA.
- 2009 TYA Evaluation, Generator Validation Study dated September 8, 2008. River Bend D-T Study Dated December 2010 covers any changes in the local area.
- "Final ISIS Report Point Beach Generators Manitowoc County, Wisconsin MISO #G833/J022 (#39297-01), G834/J023 (#39297-02)" dated October 2, 2009. A single NERC Category C9 was evaluated to ensure full compliance with applicable NERC standards.
- Addition of redundant bus differential relays required per 2010 TYA.
- Addition of redundant bus differential relays and reduction of delayed clearing times required per 2010 TYA.
- "Interconnection System Impact Study Report 50 MW Wind Generation Grant County, Wisconsin J084" dated June 24, 2010
- "Presque Isle Special Protection System "Remedial Action Tripping Scheme" (RATS)" Version 3.0 dated December 17, 2007. Presque Isle will be re-studied as part of the next SPS review.

Notes (Continued):

- (14) "Interconnection System Impact Study Report 99 MW Wind Generation Revision 4; Calumet County, Wisconsin" - MISO #G611 (#38791-01)" dated October 24, 2008.
"Interconnection System Impact Study Report 1.5 MW Wind Generation; Calumet County, Wisconsin" - MISO #G927 (#39423-01)" dated May 16, 2008.
- (15) "Interconnection System Impact Study Report 99 MW Wind Generation Revision 3; Columbia County, Wisconsin" - MISO #G706 (#39041-01)" dated September 4, 2008.
"Interconnection System Impact Study Report 150 MW Wind Generation Revision 2; Columbia County, Wisconsin" - MISO #H012 (#39567-01)" dated July 13, 2009.
Glacier Hills will be commercial by the end of 2011 and will be put into the rotation of studied generators beginning with the 2012 TYA study.
- (16) "Interconnection Evaluation Study Report 98 MW Wind Generation; Fond du Lac County, Wisconsin" - MISO #G427 (#38121-01)" dated December 22, 2004.
- (17) Until a generator declares commercial operation, an assessment of this facility will not be completed as part of the current Ten Year Assessment.
- (18) Two NERC Category D3 contingencies resulted in un-acceptable performance for ATC post-contingency voltage recovery criteria. Re-setting breaker failure relays for these contingencies result in meeting applicable ATC planning criteria. No angular instability was identified for these contingencies. All applicable NERC planning criteria was met for these contingencies.
- (19) Nine NERC Category D2 and three NERC Category D3 contingencies resulted in un-acceptable performance for ATC stability and post-contingency voltage recovery criteria. Re-setting breaker failure relays for the category D2 and D3 contingencies result in meeting applicable ATC criteria. All applicable NERC planning criteria was met for these contingencies.
- (20) No angular or voltage stability concerns were identified for this generator for the 2011 TYA.